

# Health Effects of Sulfur Dioxide

## Grades

High School

## Subjects

Science (Biology, Chemistry) and Health

## Type of Lesson Plan

Lab

## Suggested Duration

Day one – 20- 30 minutes

5 – 10 minutes on successive days

Final day – 20 minute wrap up

## Materials

- *Plant Observation Sheet*
- *Sulfur Dioxide Fact Sheet*
- *Health Effects of Sulfur Dioxide Worksheet*
- Large clear plastic bag
- Tape
- 2 Green plants in a pot (small)
- Small beaker (50-100 ml)
- Sodium nitrate (2g)
- Sulfuric acid (5%)

## Objectives

TLW...

- Observe the effects of sulfur dioxide gas on plant life.
- Be able to understand the potential health effects of sulfur dioxide on humans.
- Be able to obtain information from a government agency fact sheet.

## Instructional Input

Sulfur dioxide has adverse health effects on plants and animals. This demonstration will expose a plant to a high concentration of sulfur dioxide gas in a closed container for a brief period of time. This is known as an acute exposure (an exposure to a chemical over a short period of time, generally less than 2 weeks) as opposed to a chronic exposure (an exposure to a chemical over a long period of time, generally a year or more).

It is important to distinguish between acute and chronic exposures. The two types of exposures generally involve different concentrations of chemical exposure as well as differing health effects.

Since the plant will be acutely exposed to a high concentration of sulfur dioxide gas, the effects on the plant will be rapid and severe. This experiment involves toxic sulfur dioxide gas. Teachers should complete this experiment as a demonstration, rather than allowing the students to perform it. Teachers should use a vent hood or conduct the demonstration outside.

## **PROCEDURE**

1. Allow the students to make observations of the plant before placing it in the bag.
2. Place 2 grams of sodium nitrate in the small beaker.
3. Place the beaker and the potted plant inside the plastic bag.
4. Add 2 ml of 5% sulfuric acid to the small beaker and seal the bag shut with the tape.
5. If sulfur dioxide gas leaks from the bag, you will notice a rotten egg smell. Move the students away from the bag until the reaction is complete.
6. Leave the plant in the closed bag for at least 10 minutes.
7. Cut the bag open and allow the gas to disperse.
8. After the plant has aired out, take it back to the classroom.
9. Be sure to wash your hands.
10. Allow the class to make observations of the plant after it has aired out on their *Plant Observation Sheet*. Have them compare it to their initial observations and make note of any changes. Repeat the observation and recording over the next few days. Use the unexposed plant as a comparison.

## **Evaluation**

Make sure the students note the color, leaves, and overall appearance of the plant compared with the health of the unexposed specimen. What do they think might have happened to the plant if it had been exposed to a smaller dose over a longer period of time? Ask the class if they think sulfur dioxide gas might cause adverse health effects in humans.

## **Guided Practice**

Hand out the *Sulfur Dioxide Fact Sheet*. Allow students time to read through it on their own, or read through it as a class. Solicit reactions about the potential health effects and sources of sulfur dioxide. Next, hand out the *Health Effects of Sulfur Dioxide Worksheet*.

Correct the *Health Effects of Sulfur Dioxide Worksheet* as a class, or have the students hand them in. Go over the answers in detail, pointing out the location of the answer within the text of the fact sheet.

## **Extended Practice**

If you want to spend more time on this subject, you could prepare and administer a brief quiz, or have the students react to the lesson in their daily journals.

## **Closure**

Sulfur dioxide is a toxic substance. The main sources of sulfur dioxide are related to combustion. How can sulfur dioxide emissions be reduced? What are some alternatives to creating sulfur dioxide?

# Plant Observation Sheet

Name \_\_\_\_\_

Please fill out the table according to your observations. You may wish to make sketches in the boxes or on the back. Keep track of this observation sheet; you will need it over the next few days.

	color	leaves	stem	overall
<b>Before exposure</b>				
<b>After exposure</b>				
<b>One day after exposure</b>				
<b>Two days after exposure</b>				
<b>Three days after exposure</b>				

# Health Effects of Sulfur Dioxide

Name \_\_\_\_\_

Date \_\_\_\_\_

Give a physical description of sulfur dioxide.

Sulfur dioxide, when combined with moisture can form \_\_\_\_\_.

About \_\_\_\_\_ of all the sulfuric acid in the atmosphere is caused by humans.

List at least 4 sources of sulfur dioxide.

_____	_____
_____	_____

In sentence form and in your own words, describe how people are exposed to sulfur dioxide.

List four health effects caused by a short-term (a few minutes) exposure to sulfur dioxide.

_____	_____
_____	_____

When sulfur dioxide combines with moisture in your lungs, it can form \_\_\_\_\_.

List four health effects caused by long-term exposure to sulfur dioxide.

_____	_____
_____	_____

List four groups of people who may be more sensitive to sulfur dioxide than others.

_____	_____
_____	_____

# Health Effects of Sulfur Dioxide

Name \_\_\_\_\_KEY\_\_\_\_\_

Give a physical description of sulfur dioxide.

Sulfur dioxide can be found as a liquid or a gas. It is colorless with a strong odor.

Sulfur dioxide, when combined with moisture can form sulfuric acid.

About one third of all the sulfur compounds in the atmosphere is caused by humans.

List at least 4 sources of sulfur dioxide.

- **Burning fossil fuels**
- **Fertilizer manufacturers**
- **Wood and paper mills**
- **Metal smelters**
- **Refineries**
- **Power plants**

In sentence form and in your own words, describe how people are exposed to sulfur dioxide.

**If people breathe air with sulfur dioxide in it, they may be exposed.**

List four health effects caused by a short-term (a few minutes) exposure to sulfur dioxide.

- **Difficulty breathing**
- **Irritation of the nose, throat, lungs**
- **Coughing**
- **Shortness of breath**
- **Fluid in lungs**
- **Forms sulfuric acid in lungs**

When sulfur dioxide combines with moisture in your lungs, it can form sulfuric acid.

List four health effects caused by long-term exposure to sulfur dioxide.

- **Temporary loss of smell**
- **Headache**
- **Nausea**
- **Dizziness**
- **Irritation of lungs**
- **Phlegm**
- **Coughing**
- **Shortness of breath**
- **Bronchitis**
- **Reduced fertility**

List four groups of people who may be more sensitive to sulfur dioxide than others.

- **Children**
- **Elderly**
- **People with asthma**
- **People with chronic lung disease**
- **People with cardiovascular diseases**



## IDAHO DEPARTMENT OF HEALTH & WELFARE

### Bureau of Community and Environmental Health

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#### Sulfur Dioxide Fact Sheet

##### **What is it?**

Sulfur dioxide (SO<sub>2</sub>) is considered a pollution problem worldwide. SO<sub>2</sub> is a colorless gas or liquid with a strong odor, which affects the human respiratory system and aggravates cardiovascular disease. When SO<sub>2</sub> combines with moisture in the atmosphere, it can form sulfuric acid. Sulfuric acid is the main component of acid rain. Acid rain can harm humans, animals, vegetation, and can erode buildings, statues, and other structures.

##### **Where does it come from?**

Human beings cause the release of about one-third of all sulfur compounds in the atmosphere. SO<sub>2</sub> is released when fossil fuels are burned (coal, oil, gasoline, and diesel fuel). Most SO<sub>2</sub> is caused by stationary sources such as fertilizer manufacturers, power plants, refineries, wood and paper mills, metal smelters, and other industrial processes.

##### **How can a person be exposed?**

Exposure to SO<sub>2</sub> happens when people breathe in SO<sub>2</sub> fumes from the air. Living next to industries that generate SO<sub>2</sub> will greatly raise a person's risk of exposure.

##### **What are the effects of SO<sub>2</sub> on human health?**

Healthy people exposed to 1.5 parts per million (ppm) of SO<sub>2</sub> for a few minutes may have temporary difficulty breathing normally. Breathing SO<sub>2</sub> can irritate the nose, throat, and lungs causing coughing and shortness of breath. A brief exposure to higher concentrations of SO<sub>2</sub> (400 ppm) can cause severe shortness of breath and a build-up of fluid in the lungs (pulmonary edema, a medical emergency). SO<sub>2</sub> can go deep into the lungs where it combines with moisture to form sulfuric acid, possibly causing permanent lung damage.

Long term exposure to SO<sub>2</sub> at lower concentrations can cause temporary loss of smell, headache, nausea, and dizziness. SO<sub>2</sub> can irritate the lungs causing phlegm, coughing, shortness of breath, development of bronchitis and other respiratory diseases, as well as aggravation of existing cardiovascular disease. Long term exposure to SO<sub>2</sub> may also decrease fertility in males and females.

##### **Who is most sensitive to SO<sub>2</sub>?**

Because children breathe in more air for their body weight than adults do, children can be more sensitive to the effects of SO<sub>2</sub> than adults. Long term exposure to SO<sub>2</sub> can change a child's ability to breathe deeply. Increased respiratory illness, wheezing fits, and respiratory related emergency room visits are possible effects of long term exposure to SO<sub>2</sub> for children.

Individuals with asthma, the elderly, and those with cardiovascular or chronic lung disease (bronchitis, emphysema) are also sensitive to the effects of SO<sub>2</sub>. In fact, these people may be sensitive to lower concentrations of SO<sub>2</sub> than healthy people.

## **When may levels of SO<sub>2</sub> be unhealthy?**

The Idaho Department of Environmental Quality (IDEQ) announces air quality advisories when levels of pollution could possibly harm human health. These advisories are more common in the winter months when weather inversions occur. During inversions, air pollution is trapped close to the ground and can not escape to the upper atmosphere. The longer the inversion lasts, the more concentrated the pollution becomes potentially reaching unhealthy levels.

## **How can I protect myself from exposure to unhealthy levels of SO<sub>2</sub>?**

Listen for air quality advisories from the IDEQ. Local TV news stations, radio stations, and newspapers will carry advisories. You can also visit the IDEQ daily report web site at <http://www.deq.state.id.us/air/air1.htm>.

When levels of SO<sub>2</sub> are high, avoid moderate exercise and stay indoors. This is especially important for sensitive people. The American College of Sports Medicine defines moderate exercise as any activity level which maintains 55-75% of a person's maximum heart rate. To calculate the heart rate you need to stay below to avoid moderate exercise, subtract your age from 220 and multiply by 0.55 ( $[220 - \text{age}] \times 0.55$ ).

## **For more information:**

The Bureau of Community and Environmental Health (BCEH), Idaho Division of Health, works to protect human health from dangerous substances in the environment. This fact sheet has been created to assist you in understanding what effects exposure to SO<sub>2</sub> can have on human health. For further information about the Bureau, hazardous waste sites, and dangerous substances, contact:

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